1A Operations

Louis R. Ignaczak

Glenn Research Center

ACTS Operations

Center:	GRC	**POC:**	Lou Ignaczak	**Date:**	3/25/1999
Funding Enterprise:	Code M/SOMO	**Phone:**	216.433.6607	**NTIDB Record #:**	447
UPN-5:	315-90	**email:**	louis.ignaczak@grc.nasa.gov	**Tech Prog Element #:**	1A

DESCRIPTION: **Current TRL:** 9 **Planned TRL:** 9

- ACTS Operations is the foundation to keep the ACTS system available. It includes the prime contractors for spacecraft operation (Lockheed Martin) and the payload operations at the NASA Ground Station (Comsat); the support service contractor team (Analex) for experiment operations; and costs for operations and maintenance of the GRC facility. Some charges are still being realized in *shaking-out* the transition to inclined orbit operations.

JUSTIFICATION:

- ACTS is the only currently available satellite testbed operating in the US at Ka-band frequencies (30/20 GHz).
- Experiments are typical of those being proposed on the next generation of commercial satellite systems (multiple beam antenna, baseband switching and routing, and wideband channels that can support data links of up to 622 Mbps.)
- The associated network of ground stations provides several options for size and throughput capabilities that best matches the application and supports the verification of commercial protocols over space links
- The ACTS test bed is ideal for technology verification, wideband Earth-GEO protocol evaluation, and interface development.

RESOURCES ($K):

	FY98	FY99	FY00	FY01	FY02	FY03
Guideline	4190	4385	3820	0		

MILESTONES:

- 8/99 Complete Year 1 of inclined orbit operations
- 8/00 Complete Year 2 of inclined orbit operations
- 9/00 End operations - Spacecraft inert in super sync orbit

STATUS:

- Spacecraft healthy and operating without problems
- Ground segment operations I/O-ready and supporting experiment requirements

ACTS Operations

CUSTOMER(S):

See Technology Verification and Networking Experiments Sections

MISSION RELEVANCE:

Safeguard a unique NASA asset and assure the Space and Ground Segments of the ACTS system are reliably available to support Experiment operations.

MAPPING TO STRATEGIC ROADMAP:

Pillar 1: Reduce Cost of NASA Space Operations	1. Commercial Utilization	X	**Pillar 2:** Provide enabling data services to Enterprises	1. High Performance Comm	X
	2. Network Interoperability	X		2. Intelligent Syst & Autonomy	
	3. System Automation			3. Innovative Info Syst	
	4. Process Tools			4. Environm Characterization	X

INTER-RELATIONSHIPS:

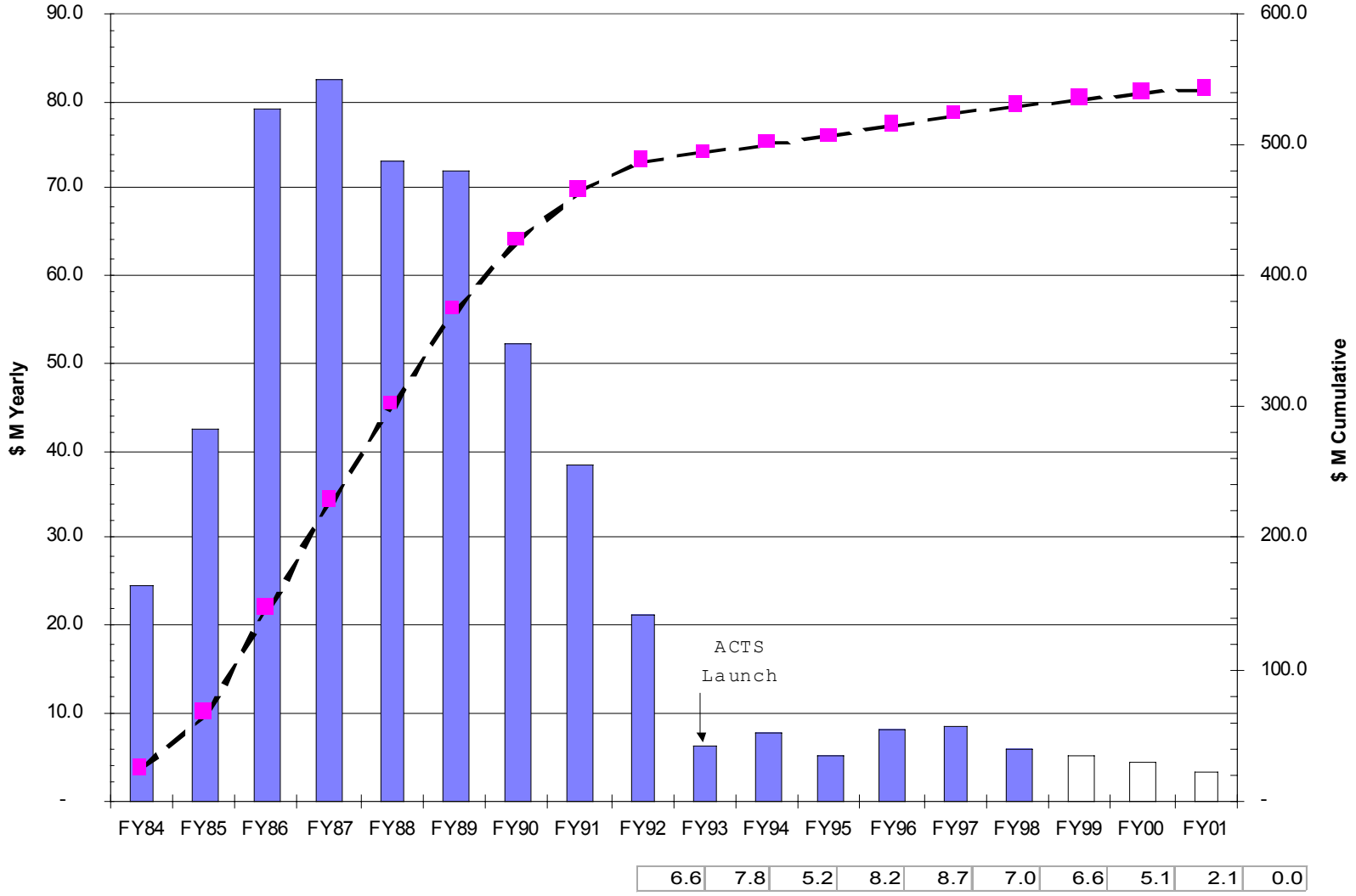
- Experiment operations partially supported through reimbursable agreements with other government agencies, industry and universities.

IMPACT OF CANCELLATION :

- Loss to the Nation of a unique fully operational satellite test bed
- GRC SCP personnel directly: 14 CS; 16 on-site contractors, 9 off-site
  - Limits Leveraging of current workforce into future benefits
- Closeout of flight operations requires about of 3 months
- Closeout of ground segment requires about 6 months

ACTS Funding History

Incremental further funding to gain maximum benefit from nearly $1B total in ACTS



ACTS Operations

NASA Ground Station

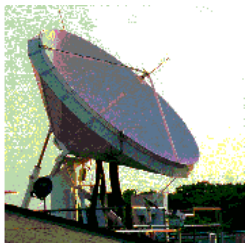
- At Glenn Research Center
- Operated by Comsat Labs
- Payload operations - 24 X 7
- Full S/C operations monitor redundancy
- All Ka-band communications to S/C
  - Command & control
  - Telemetry

Space Operations Center

- Lockheed Martin Missiles & Space, Newtown, PA
- Spacecraft operations - 24 X 7
- Command file generation
- Housekeeping, attitude control, stationkeeping
- Terrestrial connection to NGS

Independent control & facilities by design

ACTS System Overview



High Gain, Fast Hopping Spot Beams

- EIRP >64 dB
- G/T >20 dB/K
- Frequency Reuse >> 4
- 20 dB improvement over CONUS beams

Onboard Processing & Switching

- Baseband Switching at 64 kbps circuit level
  - Max throughput of 220 Mbps
  - Full mesh, single hop connectivity
- Wideband Switch Matrix of 3 channels at 900 MHz each

Ka-Band

- 30/20 GHz RF spacecraft & earth station components
- Adaptive rain fade compensation
  - Propagation measurements to characterize band
- Only currently available 30/20 GHz satellite testbed in U.S.

1B Technology Verification Experiments

Roberto J. Acosta

Glenn Research Center

ACTS Technology Verification Experiments

Center: GRC
Funding Enterprise: Code M/SOMO
UPN-5: 315-90

POC: Dr. Roberto Acosta
Phone: 216.433.6640
email: r.acosta@grc.nasa.gov

Current TRL: 2

Date: 3/25/1999
NTIDB Record #: 447
Tech Prog Element #: 1B
Planned TRL: 2

DESCRIPTION:

- Perform statistical investigations of all aspects of system availability at 30/20 GHz Ka-band frequencies using ACTS; includes the ACTS propagation rain fade measurements program.
- Specific areas include: multibeam antenna performance in inclined orbit operations, fade characterization and mitigation, antenna wetting effects, cross-polarization discrimination, wideband dispersion, and GEO/LEO interference.

JUSTIFICATION:

- NASA missions such as TDRSS and the Deep Space Network are currently using the the TVE results to make critical design changes for increasing systems availability in future Ka-band upgrades and inclined orbit operations.
- All major US commercial system developers have used, and express continued interest in our lessons learned from the TVE's on their Ka-band designs. This will result in more competitive services and lower costs to NASA.
- August 1998 Program Readiness Review recommendation from industry/Gov.. review team strongly endorsed these activities as being among the best uses of ACTS during inclined orbit operations.

RESOURCES ($K):

	FY98	FY99	FY00	FY01	FY02	FY03
Guideline	1800	1365	770	135		

MILESTONES:

- 4QFY99 - Complete 1st yr.. inclined orbit statistical characterization
- 3Q FY00 – Complete multi-beam antenna performance data collection
- 3Q FY00 – Complete full year cross polarization data collection
- 4Q FY 00 – Complete wideband dispersion data collection
- 4QFY00 – Complete Ka-band GEO/LEO interference data collection
- 4QFY00 – Complete high-risk experiments of ACTS system
- 4QFY00 – Complete 2nd yr. inclined orbit statistical characterization

STATUS:

- 6 TVE's are underway in-house; 2 experiments planned to meet 8/98 industry/Gov.. review team recommendations.
- An HBCU grant is in place to enhance system knowledge in SCADA applications
- Spacecraft and technical experiment data regularly processed for analysis. Data published/presented at least twice per year.
- 5 years statistical propagation data collected from 7 sites across N.America - follow-on work continues at 2 sites.

ACTS Technology Verification Experiments

CUSTOMER(S):

- JPL - Deep Space Network
- NASA GSFC - TDRSS program
- NASA ISS - project communications
- US SatCom Industry
- Other Gov.. agencies

See supporting chart for details

MISSION RELEVANCE:

- Both the Deep Space Network and TDRSS use the results of the TVE's, especially the rain fade characterization work, in improving systems designs for their Ka-band operations
- Key design rules and knowledge are being developed with our in-house TVE's to provide NASA's systems solutions relevant to Ka-band communication design trade-offs for making systems more cost effective.
- Industry is also benefiting from our lessons learned and design trade-offs. The knowledge gained is being used to reduce cost of operations and services which is in NASA's and the country's best interest.

MAPPING TO STRATEGIC ROADMAP:

Pillar 1: Reduce Cost of NASA Space Operations	1. Commercial Utilization	X	**Pillar 2:** Provide enabling data services to Enterprises	1. High Performance Comm	X
	2. Network Interoperability			2. Intelligent Syst & Autonomy	
	3. System Automation			3. Innovative Info Syst	
	4. Process Tools			4. Environm Characterization	X

INTER-RELATIONSHIPS:

- Stanford Telecom (MD) is working with DoD to continue propagation experiments
- Univ. South Florida/Florida Atlantic University - Florida propagation site has obtained non-ACTS funding to continue data collection and will provide data to NASA
- Savannah State University/Florida Solar Energy Center (HBCU grant)

IMPACT OF CANCELLATION or DELAY :

- Nation would experience a shortfall in the system data being used to guide design and deployment of commercial Ka-band systems.
- NASA missions benefit from our knowledge base gained from the TVE's to successfully operate a Ka-band system. This may reduce the risk of poorly developed systems needing costly modifications later on.

ACTS Technology Verification Experiments
Customers

JPL - Deep Space Networks
- Dr. William Imbriale, Senior System Engineer
- Dr. Anil Kantak, Senior System Engineer
- Dr. Nasser Golshan, Manager

NASA GSFC - TDRSS Program
- Anthony Comberiate, TDRS Project Manager (H,I,J)
- Marco Toral, Payload Technical Manager

NASA ISS - Project Communications
- Dr. Michael Jacox, System Director

Government Agencies
Department of Defense/Aerospace Corp. (GBS)
- Dr. Allyson Yarbrough, Senior Engineer
Department of Defense/MITRE
- Dr. Richard Gibbons, Senior System Engineer

US Satellite Communication Industry

Lockheed Martin
- Karl Savatiel, Vice President, Business Development, LMGT
- Dr. Jerry Hopponen, Senior Engineer, Astrolink

Hughes
- Dr. Thomas Brackey, Executive Director, Technical Operations, HSC
- Dr. Leonard Golding, Vice President, HNS
- Dr. Faramaz Davarian, Chief Technologist

TRW
- Dr. Harvey Berger, Senior Engineer

Space System Loral
- William Nations, Director
- Carl Mitchell, Senior System Engineer
- Dr. Jerry Fiedziuszko, Chief Scientist

Motorola
- Richard Astrom, Principal Systems Engineer
- Dr. Kenneth Peterson, Member Technical Staff Satcomm Govt. & Space Technology Group

Teledesic
- Zlata Koro, Systems Engineer

Orbital Sciences
- Greg Giffen, Systems Engineer Advanced Projects

ACTS Technology Verification Experiments

Recent Publications

- R. Acosta, R. Bauer, M. Zernic, R. Krawczyk, R. Reinhart ”4th year ACTS system Performance,"***International Journal of Satellite Communications***, Vol. 10, January 1999.
- R. Acosta, “Wet Antenna Effects on Ka-Band Systems”, ***National Radio Science Meeting-URSI 99***, Boulder, CO, January 4-8, 1999.
- R. Acosta,"Antenna Wetting Effects on Ka-Band Low Margin System", ***4th Ka-Band Utilization Conference,*** Venice, Italy, November 2-5, 1998.
- C. Cox & T. Coney, "Advanced Communications Technology Satellite Adaptive Rain Fade Compensation Protocol Performance",***4th Ka-Band Utilization Conference***, Venice, Italy, November 2-5, 1998.
- S. Johnson, "Lessons Learned from the ACTS T1 VSAT Experiment Program", ***4th Ka-Band Utilization Conference***, Venice, Italy, November 2-5, 1998.
- R. Acosta, "Rain Fade Compensation Alternatives for Ka-Band Communication Satellites", ***3rd Ka-Band Utilization Conference***, Sorrento, Italy, September 15-18, 1997.

ACTS Technology Verification Experiments
Experiment Summary

On-going:

ACTS System and Rain Fade Statistical Characterization

1 The effects of Ka-Band propagation and system effects (MBA thermal) on ACTS VSAT performance during inclined orbit are investigated and analyzed using statistical performance indices like **system fade availability** and fade exceeds over several years.

2 The deterministic or time domain analysis of the effects of **adaptive rain fade compensation** at Ka-Band on the ACTS VSAT performance during inclined orbit is investigated.

3 The **multibeam antenna pointing accuracy** is evaluated every 6 month during inclined orbit. The metric for performance is the overall multibeam antenna pointing stability as a function of orbit inclination angle.

Ka-Propagation Related Investigations:

4 The deterministic-time domain and statistical analysis of **antenna wetting effects** at Ka band in low margin system (USAT) in a sub-tropical rain zone during inclined orbit is investigated

5 Conduct statistical **de-polarization data** collection for a medium rain zone Maryland / D.C. areas.

6 Conduct statistical **short distance diversity** in sub-tropical rain zone (Florida)

Planned TVEs (Per recommendation of 8/98 Industry/Govt. Review Team):

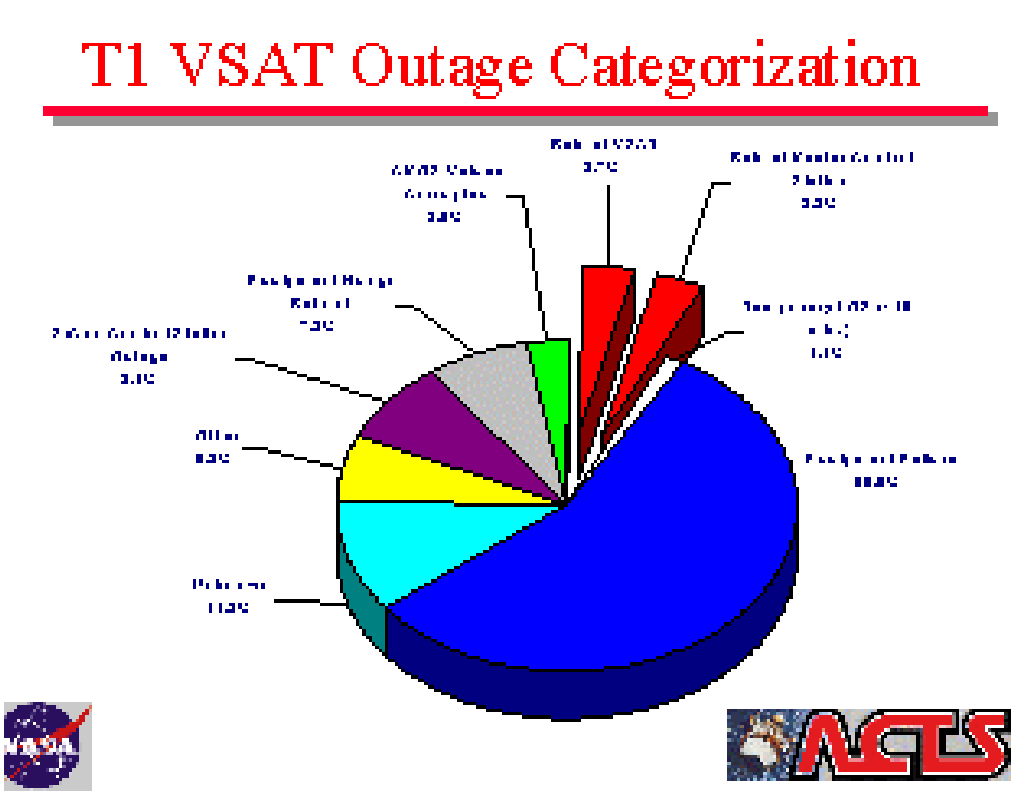
System and propagation investigations at Ka Band

7 Conduct **GEO/LEO interference** measurements between ACTS and IRIDIUM.

8 Conduct **wideband dispersion measurements** due to rain using 500 MHz bandwidth wideband channel.

9 **High Risk** ACTS system investigations using configurations never used in regular operations.

ACTS Technology Verification Experiments
Investigations Results



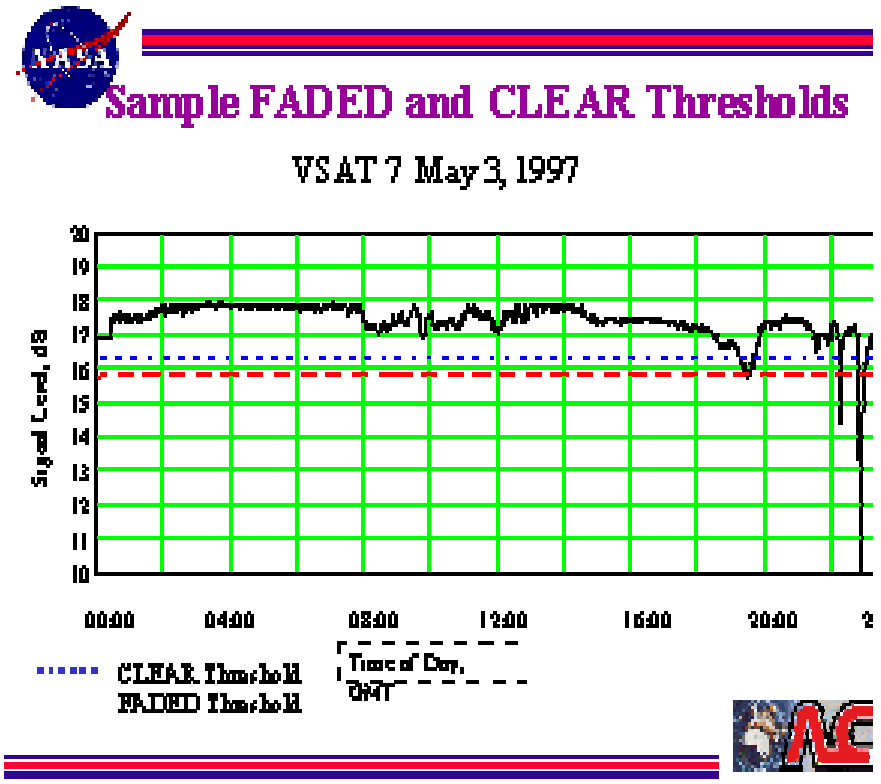


Figure 1: On-going TVE #1, "System Characterization (Statistical)"

Figure 2: On-going TVE #2, "Rain Fade compensation Characterization (Deterministi

Note: Web page has a copy of papers and presentations
http://kronos.grc.nasa.gov/acts/tve.html

ACTS Technology Verification Experiments

Investigations Results

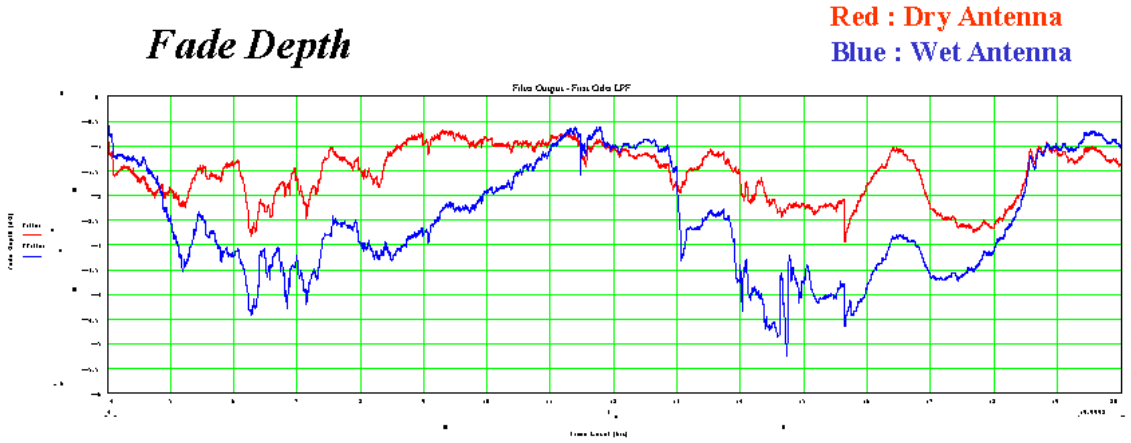


Figure 3: On-going TVE #4, “Antenna Wetting(deterministic)”

Biax-Drive Compensation

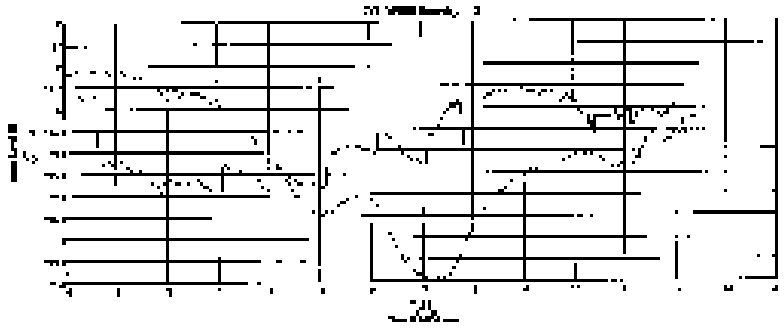


Figure4: On-going TVE #3, “Multibeam Antenna Pointing”

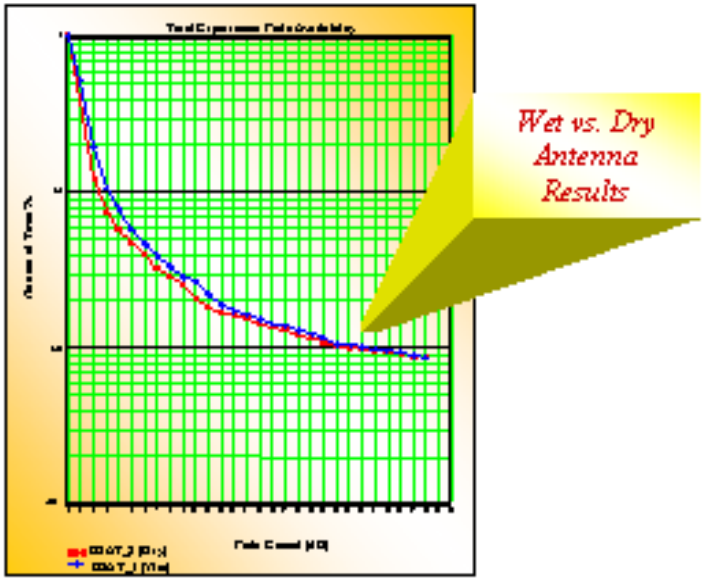


Figure 5: On-going TVE #4, “Antenna Wetting (Statistical)

1C Networking Experiments

Michael J. Zernic

ACTS Networking Experiments

Advanced Communications Technology Satellite (ACTS)

Experimenting Through the Year 2000

NASA Glenn Research Center's ACTS Project is available for research opportunities in:

Demonstrating NASA and Other Government Use of Future Satellite Service

ATM, IP, and Other Protocols Over Satellites, Including Interoperability with Terrestrial Networks

Evaluating Satellite Inclined Orbit Operations

New Ka-band Technology and Hardware Verification

Over 7000 satellite hours,
16 experiments,
35 government / industry partners

Glenn Research Center

ACTS Networking Experiments

Center:	GRC	**POC:**	Mike Zernic	**Date:**	3/25/1999
Funding Enterprise:	Code M/SOMO	**Phone:**	216.433.5286	**NTIDB Record #:**	447, 9462
UPN-5:	315-90, 632-50	**email:**	mzernic@grc.nasa.gov	**Tech Prog Element #:**	1C

DESCRIPTION: **Current TRL:** 4 **Planned TRL:** 6

- ACTS represents the next generation of commercial satellite systems, services, and corresponding technology
- The unique ACTS technologies enable the experiments program to continue to exploit opportunities primarily in demonstrating NASA and other government use of future satellite systems as well as investigating space-terrestrial network interoperability and protocol standards issues

JUSTIFICATION:

- ACTS-based networking experiments are critical for early demonstration and evaluation of CSOC IOA interoperability concepts
- Early contributions to the CSOC communication architecture roadmap will be made because ACTS offers a proven Ka-band, high data rate capability of up to 622 Mbps which is not available anywhere else
- Of special technology and cost reduction significance are the direct contributions to the activities and milestones associated with Network Interoperability & Standards and with Commercial Asset utilization (spacecraft as an internet node milestone by 2003)
- These types of experiments validate theory, hypotheses, and ground simulation over a legitimate space-based testbed with commercial-grade terrestrial components

RESOURCES ($K):

	FY98	FY99	FY00	FY01	FY02	FY03
Guideline	1,040	830	375			

MILESTONES:

- Q1FY99 Complete consortium 622Mbps experiment (#118x)
- Q2FY99 Complete NRL experiment (#149)
- Q3FY99 Initiate consortium follow-on (#154 builds on #118x)
- Q3FY99 Relocate ACTS HDR station to CSOC Central
- Q3FY99 Initiate NRL follow-on (#151 build on #149)
- Q3FY99 Initiate CSU-H satellite ops experiment (#152)
- Q4FY99 Complete AFRL SCPS experiment (#131)
- Q3FY00 Complete all ACTS networking experiments

STATUS:

- SOMO convened independent government-industry review (4QFY98) recommended continuance through 4QFY00
- Experiments Program goals are aligned with SOMO/CSOC/IOA
- CSOC IOA concepts based upon ACTS networking experiments
- ACTS HDR station relocation to Houston will support IOA implementation - Q3FY99

ACTS Networking Experiments

CUSTOMER(S):

- SOMO: address IOA technology gaps and standards issues via validations and demonstrations
- Other NASA Enterprises: contribute to enhanced data/mission services
- Industry and other government organizations: experiments have catalyzed partner relationships between government research labs, the computing industry, the telecommunications industry, and the satellite industry

MISSION RELEVANCE:

- IOA: address and/or accelerate IOA objectives and milestones
- SOMO: clear mapping to strategic roadmap (reference experiment examples to follow)

MAPPING TO STRATEGIC ROADMAP:

Pillar 1: Reduce Cost of NASA Space Operations	1. Commercial Utilization	X	**Pillar 2:** Provide enabling data services to Enterprises	1. High Performance Comm	X
	2. Network Interoperability	X		2. Intelligent Syst & Autonomy	
	3. System Automation			3. Innovative Info Syst	X
	4. Process Tools			4. Environm Characterization	

INTER-RELATIONSHIPS:

- DARPA has been a significant funding partner of the ACTS HDR capability and high performance networking objectives (DARPA has contributed in excess of $6M through 1997, but currently all funding in this area comes from NASA)
- Public-Private relationships have promoted network interoperability (currently, in-kind contributions of over $1 M on average demonstrates leveraging of govt. funds in achieving its objectives)
- Other interests in Ka-band satcom and network validation have generated modest reimbursable agreements

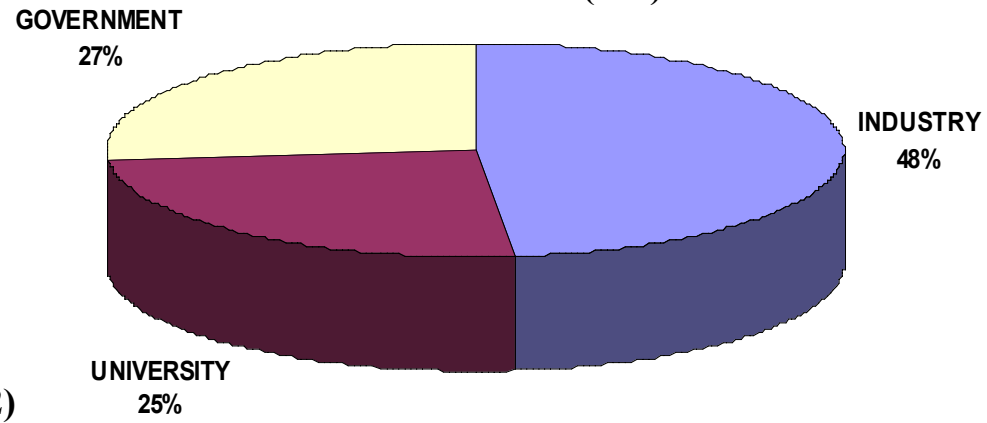
IMPACT OF CANCELLATION or DELAY :

- Customers would be denied the only Ka-band satcom testbed available and these primary areas would suffer: 1) identify, address, or mature technology and standards gaps in the IOA, and 2) NASA's transition to commercial assets
- Question of savings regarding a project that has significant yield and has a known termination in Q4FY00
- Delay technology transfer for commercial service implementation
- Other Programs: Loss of contributions to customers and loss of leveraged inter-relationships (see above section)

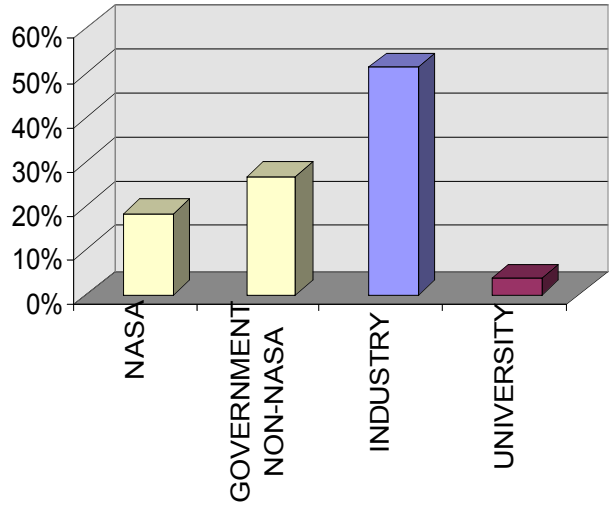
ACTS Experiments & Demonstrations

ACTS Experiment Utilization

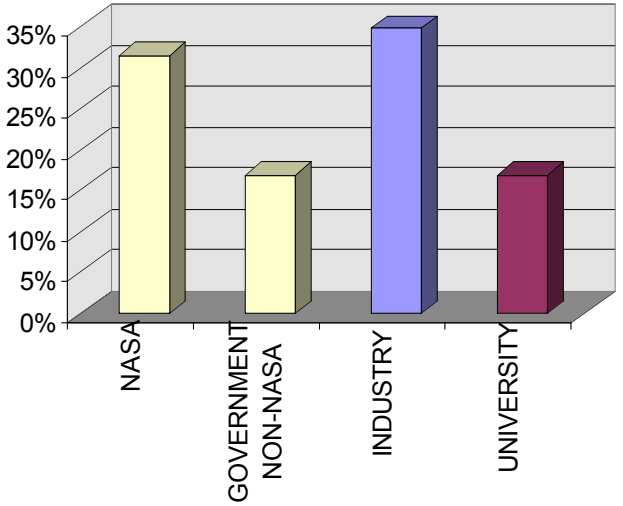
PARTICIPANTS (120)



DEMONSTRATIONS (82)



EXPERIMENTS (89)



NETWORKING EXPERIMENTS (present through ACTS EOL)

- **Active Space Act Agreements:** AFRL, CMU, NRL, INTELSAT, SSU HBCU, GRC CETDP
- **Agreements Under Development:** CSU-H, SAIC/Bellcore, SWRI, JPL, Raytheon, LMSOC

Multi-platform, High Speed GEO Protocol Performance
ACTS Experiment #118x

Accomplishments

- Catalyzed a cross-industry partnership among competitive entities
  - Sun Microsystems, Microsoft, Intel, DEC., Pittsburgh Supercomputing Center
  - Sprint, Fore Systems, Cisco Systems, Ampex Data Systems
  - Lockheed Martin, Hughes Space&Com, Spectrum Astro, Space Systems Loral
  - GRC, JSC, JPL, LLNL, NRL
- Promoted non-biased technology transfer in area of communication interoperability (622 Mbps bi-directional)
- Operated various industry TCP “off the shelf” implementations in a “stressed” network environment
- Dispelled myth that TCP/IP does not perform well in hybrid network architectures, especially involving geo-stationary satellites

Relevance to NASA, SOMO, GRC, ACTS, Industry, and other Government Organizations

- Government Space ops cost reduction
  - Commercial asset utilization
  - Interoperability and Standardization
- NASA Enterprise data/mission services
  - High Performance Communications
  - Hybrid Network Ubiquity

By-Products

- Contributes to IETF and other standards bodies
- Enables unique technology transfer and NASA migration to commercial assets
  - Convergence of satellite, telecom, and computing industries
  - Divergence of proprietary/point solution communication architecture components

Estimated value of contribution of test team

- $1.2M worth of equipment, use of facilities, and engineering support

Next Steps

- Initiate ACTS Experiment #154 (a.k.a. “118neXt”)

Shipboard ACTS Ka-band Experiment (ShAKE)
ACTS Experiment #149

Accomplishments

- Non-reimbursable Agreement between GRC and Naval Research Laboratory
  - SeaTel, Hill Mechanical Group, FORE Systems, Xicom Technologies, Raytheon Marine Company, COMSAT Labs
- Evaluated current tracking schemes for enhanced techniques
- Operated a “stressed” network environment (vessel at sea; inclined orbit satellite)
- Investigated high speed transfer to/from remote network nodes and simultaneous applications
  - internet and world wide web access, TCP/IP based file transfers, interactive and variable TCP/IP based multi-media, production quality video, and CD quality audio
- Achieved bi-directional mobile network operating at 45 Mbps

Relevance to NASA, SOMO, GRC, ACTS, Industry, and other Government Organizations

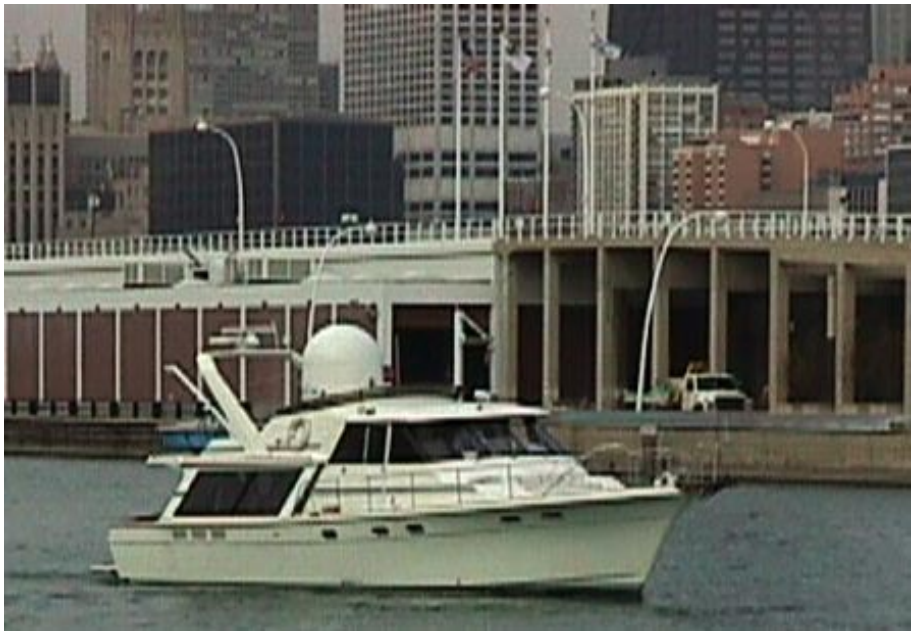
- Government Space ops cost reduction
  - Commercial asset utilization
  - Interoperability and Standardization
- NASA Enterprise data/mission services
  - High Performance Communications
  - Hybrid Network Ubiquity

By-Products

- Extrapolates to LEO/MEO tracking scenarios
- Enables environment for testing new Ka-band component technologies
- DoD assessment of Ka-band and transition to commercial assets

Next Steps

- Initiate ACTS Experiment #151



Satellite Protocol Testing & Ka-band Terminal Development
ACTS Experiment #131

Accomplishments

- Established relationship and Interagency Agreement with Air Force Research Lab and the Canadian Research Centre
- Development and test of suitcase Ka-band terminal
- Evolution to briefcase terminal
- Extensive use of Space Communication Protocol Standard (SCPS) suite
- Enabled first international dual Ka-band satellite network
  - Italsat-ACTS link between GRC and Ka-band conference in Sorrento, Italy

Relevance to NASA, SOMO, GRC, ACTS, Industry, and other Government Organizations

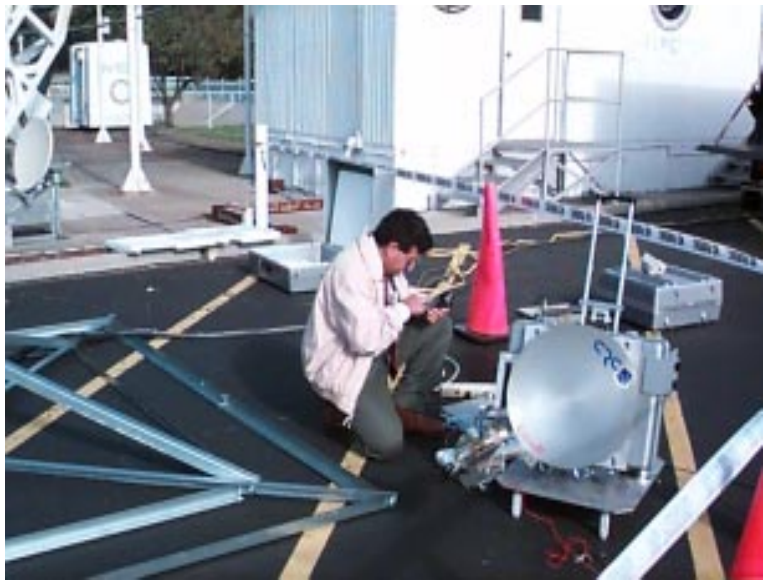
- Government Space ops cost reduction
  - Commercial asset utilization & Interoperability and Standardization
- NASA Enterprise data/mission services
  - High Performance Communications & Hybrid Network Ubiquity

By-Products

- Contributes to IETF and other standards bodies
- Enables unique technology transfer opportunities
- DoD Ka-band system assessment/ transition to commercial assets

Next Steps

- Continue SCPS testing
  - Windows implementation
- Mature portable Ka-band ground terminal
- Develop mobile tracking antenna
- Initiate use of spread spectrum modems
- Implement Force Level Execution (FLEX) software in tests
  - Links of varied quality
  - Multiple hop scenarios



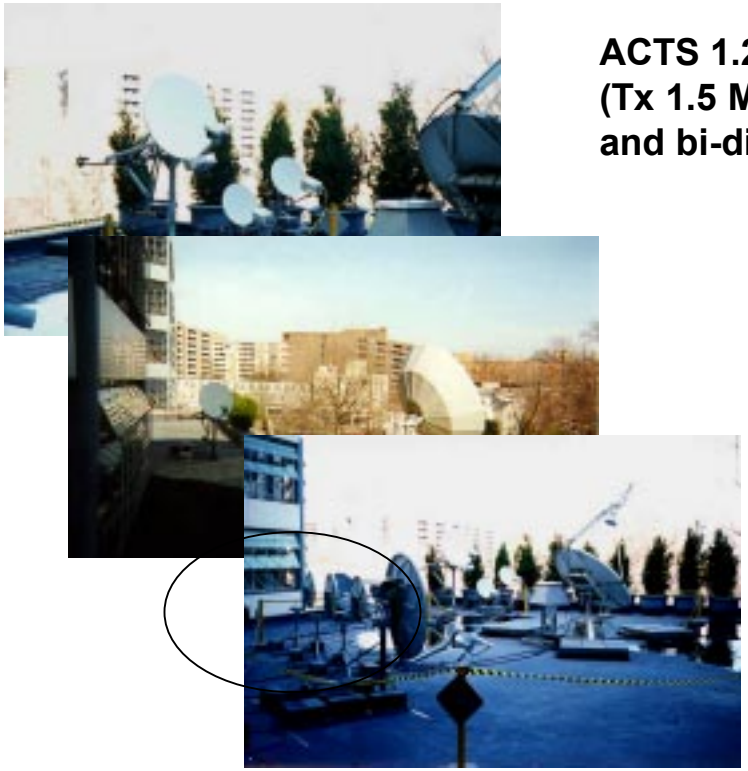
Demonstration of Ka-band suitcase terminal

INTELSAT Ku and Ka-band Comparison Demonstration
ACTS Experiment #141

Accomplishments
- Compared multi-media, internet based services on Ku-band and Ka-band systems to an international body
- Demonstrations conducted at INTELSAT in January-February 1999
  - Senior Management
  - Planning Committee
  - Technical Committee

By-Products
- International use of Ka-band technologies and high performance networking implementations

Next Steps
- Probable INTELSAT implementation of Ka-band systems and enabled services



ACTS 1.2 m hub and two 0.6 m field sites (Tx 1.5 Mbps/Rx 6.2 Mbps combined data rate for IP, ISDN, VTC, DTH and bi-directional video, TCP applications)

1.2m Ka Hub and
6.1 m Ku Hub

Three 0.6 m Ku-band terminals used for comparison (Tx 32 kbps/Rx 6 Mbps combined data rate for IP, DTH video)

Joint ACTS-Student Satellite Testbed
ACTS Experiment #152

Objectives

- Establish agreement between GRC and the California State University-Hayward, Center for Research in Telecommunications and Collaborative Technologies
- Explore and prototype unique integrated infrastructure of the internet, optical, and multi-media satellite communications
- Establish a global command and control university network for student mission control groups
  - CSU-H, Stanford, Weber State, Univ. of Alabama at Huntsville, Tuskegee Univ., Autonomous University of Mexico, Space Engineering School in Kiruna (Sweden), Moscow Aviation Institute, St. Petersburg Univ., University of Rome

Relevance to NASA, SOMO, GRC, ACTS, Industry, and other Government Organizations

- Government Space ops cost reduction
  - Commercial asset utilization
  - Interoperability and Standardization
- NASA Enterprise data/mission services
  - High Performance Communications
  - Hybrid Network Ubiquity

By-Products

- Enables international participation, especially from an international standards perspective
- Possible LEO micro-satellite interoperability opportunity
- Joint industry sponsored workshops

Next Steps

- Formalize agreement
- Initiate ACTS Experiment #152

1D ACTS Closeout

Robert A. Bauer

Glenn Research Center

ACTS Closeout

Center:	GRC	**POC:**	Robert Bauer	**Date:**	3/25/1999
Funding Enterprise:	Code M/SOMO	**Phone:**	216.433.3431	**NTIDB Record #:**	447
UPN-5:	315-90	**email:**	robert.bauer@grc.nasa.gov	**Tech Prog Element #:**	1D

DESCRIPTION: **Current TRL:** 9 **Planned TRL:** 9

- At the end of FY 00 (September), the ACTS spacecraft will super synch-orbited followed by project close-out. Plans are being developed for these close-out activities (contract close-out, earth station retrieval, earth station salvaging, experiments conclusion, conference, final report development, documentation archival) which is targeted for completion by end of FY 01.
- Investigate alternative uses for the ACTS sys tem hardware and infrastructure at the end of the project. Plans for this will be initiated prior to project shut-down so that if modifications are desired, they can commence soon after de-orbit.
- ACTS Close-out Conference in September 2000.

JUSTIFICATION:

- The ACTS system has a considerable investment (~$80M) in hardware and infrastructure that can be utilized for post-ACTS activities in the areas of transitioning to commercial assets, alternative TDRSS ground site, and network and protocol evaluation for an Integrated Operations Architecture

RESOURCES ($K):

	FY98	FY99	FY00	FY01	FY02	FY03
Guideline		25	150	1955		

MILESTONES:

- 4QFY99 Study on post-ACTS uses of NASA Ground Station
- 3QFY00 Finalize post-ACTS use of NGS, and remaining ground segment
- 9/00 Spacecraft super synch-orbit, end operations, close-out conf.
- 1QFY01 Retrieve earth stations in field
- 1QFY01 Complete experiments data analysis
- 1QFY01 Closeout Prime contracts
- 2QFY01 Complete submittal of experiment results
- 4QFY01 Complete data and record archiving

STATUS:

- Close-out plan under development and will be baselined in April 99.

ACTS Closeout

CUSTOMER(S):

- CSOC - Commercialization of assets
- NASA Standards Program

MISSION RELEVANCE:

- Gateway to commercial systems for IOA development.

MAPPING TO STRATEGIC ROADMAP:

Pillar 1: Reduce Cost of NASA Space Operations	1. Commercial Utilization	X	**Pillar 2:** Provide enabling data services to Enterprises	1. High Performance Comm	X
	2. Network Interoperability	X		2. Intelligent Syst & Autonomy	
	3. System Automation			3. Innovative Info Syst	
	4. Process Tools			4. Environm Characterization	X

INTER-RELATIONSHIPS:

- Ground segment for Direct Data Distribution will benefit from ACTS experience; may use surplus ACTS ground station equipment
- Alternative uses of earth stations being sought from NASA, other govt. or industry partners.

IMPACT OF DELAY :

- Delay of closeout impacts use of remaining fuel onboard spacecraft - raises concerns of orbital debris if not super-orbited.
- Close-out can't be cancelled; question arises on when it occurs and to what extent archiving and documenting is desired.